FORM PTO-1390 (Modified) (REV 11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR
A31222-PCT USA	09/530085

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/US97/19207	24 October 1997	

TITLE OF INVENTION

TRANSMISSION CONTROL FOR MINIMIZING CONGESTION IN DIGITAL COMMUNICATIONS NETWORKS

APPLICANT(S) FOR DO/EO/US

JACOBS, Stephen and ELEFTHERIADIS, Alexandros

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☐ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Forms PCT/IB/301/308/332; Form PCT/ISA/220; Forms PCT/IPEA/401/402/416; Form PCT/IPEA/408, response to Written Opinion, a postcard, and a check in the amount of $958.

Express Mail No. EJ339571965US
DAte of Deposit: April 20, 2000

526 Rec'd PCT/PTO 20 APR 2000

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/530085	PCT/US97/19207	A-31222-PCT USA

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO **$970.00**	
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO **$840.00**	
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$690.00**	
☒	International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$670.00**	
☐	International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$96.00**	

ENTER APPROPRIATE BASIC FEE AMOUNT =	**$670.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	36 - 20 =	16	x $18.00	**$288.00**	
Independent claims	3 - 3 =	0	x $78.00	**$0.00**	
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**	
TOTAL OF ABOVE CALCULATIONS =				**$958.00**	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)**. ☐				**$0.00**	
SUBTOTAL =				**$958.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				**$0.00**	
TOTAL NATIONAL FEE =				**$958.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				**$0.00**	
TOTAL FEES ENCLOSED =				**$958.00**	
				Amount to be: refunded	$
				charged	$

☒ A check in the amount of **$958.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **02-4377** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Henry Tang
Baker Botts LLP
30 Rockefeller Plaza
New York, NY 10112-0228

SIGNATURE

Paul A. Ragusa
NAME

38,587
REGISTRATION NUMBER

19 April 2000
DATE

TRANSMISSION CONTROL FOR MINIMIZING CONGESTION IN DIGITAL COMMUNICATIONS NETWORKS

Technical Field

The invention relates to transmissions in a digital communications network and, more specifically, to transmission control for minimizing network congestion.

Background of the Invention

For preventing loss of data due to congestion in digital network communications, a protocol known as Transmission Control Protocol (TCP) has been proposed for the Internet; see Information Sciences Institute, "Transmission Control Protocol - Request for Comments 793", September 1981 and W. Stevens, "TCP Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery Algorithms - Request for Comments 2001", January 1997. TCP is based on the notion of fair sharing of transmission resources among users.

TCP is reliable, in the sense that the data received at a destination are an exact duplicate of the data that was sent. Such reliability may be at the expense of transmission delays, however.

For some transmissions, e.g. real-time audio and video, reliability is less important, and the primary concern is with the data arriving on time. Specifically, for example, it is more acceptable to lose an occasional frame of video than to have the video start and stop repeatedly.

Summary of the Invention

For congestion control in a digital communications network such as the Internet or corporate "Intranets", and especially for real-time transmissions in such networks,

Fig. 6 is a representation of packet format for a preferred embodiment of the invention in a wireless or hybrid wired-wireless network.

Detailed Description of Preferred Embodiments

While preferred embodiments are described in the following primarily in method terms, the inventive technique also includes systems embodiments, e.g. involving a programmed processor. A prototype implementation uses a Unix Workstation as network server and a PC as client server, both programmed in C++. Use of special-purpose firmware or hardware is not precluded.

The technique is window-based in the sense that a sender maintains a count of the number of outstanding packets, i.e., packets which have been sent, but for which an acknowledgment has not yet been received from the receiver. The sender maintains current an upper bound on the number of outstanding packets allowed in the network, called the "congestion window" (CWND) and providing an indication of the available bandwidth from sender to receiver. Congestion is detected when a packet is lost in the network. Alternatively, and especially in transmissions of variable-length packets, CWND can be maintained in units of bytes rather than units of packets.

If the number of outstanding packets is less than CWND, the sender can continue to send data into the network. Otherwise, the sender must stop transmitting data until either CWND increases or the number of outstanding packets decreases. If acknowledgments are received, CWND will increase, and the number of outstanding packets will decrease. If no acknowledgments are returned, packets will timeout and be deemed lost by

"Outstanding acknowledgments" (ACK) is set to zero. "Timeout" (TO) is set to 3 seconds, for example, indicating the amount of time not to be exceeded between sending a packet and receiving its acknowledgment. If an acknowledgment is not received in time, the packet is assumed to be lost. The system starts out in a "Slow-Start Phase" indicated by Phase=SS.

Since CWND is the size of the first packet, ACK=0, and there is data available to send (namely the first packet), the first packet is sent into the network. ACK is then increased by the size of the packet sent, representing the number of bytes currently in the network that have not yet been acknowledged. The system then checks whether acknowledgments have arrived. If so, Outstanding Acknowledgments is decreased by the size of the packet to which the acknowledgment refers: ACK = ACK-size. The system then calculates the Round Trip Time (RTT), i.e. the difference between when a packet was sent and when the acknowledgment was received. RTT is used in the calculation of Timeout (TO).

The system maintains an estimate of the round trip time, RTT_{avg}, by using the measured RTT, RTT_i, for each acknowledgment. Following D. Comer, "Internetworking with TCP/IP", 3rd Edition, Simon & Schuster, 1995, pp. 191-230, RTT_{avg} and Timeout (for future use) are calculated as follows:

$$Diff = RTT_i - RTT_{avg}$$

$$RTT_{avg} = RTT_{avg} + Diff/8$$

$$Dev_i = 0.25 \cdot (|Diff| - Dev_i)$$

$$Timeout = RTT + 0.25 + 3 \cdot Dev_i$$

Now, in Slow Start Phase, CWND is increased by *size*:

$$CWND = CWND + size;$$

fills a buffer. At the server, the media pump sends the data to the client from the buffer, taking into account the current value of CWND determined in accordance with Fig. 2, and the media pump supplies the size values for congestion control. In case of significant congestion, CWND will be less than ACK, and this will stop the media pump from sending further data for a period of time, thereby reducing the media pump transmission rate.

So long as the average available bandwidth of a connection is greater than or equal to the bandwidth requirements of the media, and so long as there is sufficient buffering, the media can be played back without interruption. With congestion-minimizing processing as described above, few packets will be lost, and can be retransmitted if there is enough time.

Buffering provides for variation in the available bandwidth: the larger the buffer, the more variation can be accommodated. But there is an initial start-up delay while a client buffer is being filled, so that increased buffering results in a longer start-up delay.

As to adaptable media, there are several ways of changing bandwidth requirements. In the case of MPEG, for example, one way involves dropping frames as described by Z. Chen et al., "Real Time Video and Audio in the World Wide Web", World Wide Web Journal, Vol. 1, January 1996. The server finds the picture header in the MPEG stream and stops sending data until it finds the next picture header in the stream. This has the effect of dropping one frame from the media stream, and thereby reducing the bandwidth requirements. As frames are interdependent in MPEG, a frame should not be dropped if other frames depend on it, i.e. an I-frame cannot be dropped if the stream contains P- or B-frames which depend on it.

media being adapted. The media pump operates as in the non-adaptable case, sending data only when CWND > ACK. Based on the occupancy of the buffer, the adaptable media module is instructed to change the rate of the media.

For example, for rate control in MPEG video by frame dropping, a frame can be dropped when the buffer is more than half full; otherwise, the video is passed unaltered to the buffer. Other scenarios, using DRS and more sophisticated rate control may be implemented. For example, if the buffer is filling, the transmission rate may be reduced in inverse relationship to the rate of buffer filling.

Fig. 4 illustrates an exemplary rate control technique based on measurements of buffer occupancy. Every 5 seconds, an average buffer occupancy is obtained for the previous 5 seconds, $Occupancy_i$. The change in the buffer occupancy since the previous 5-second interval, $Occupancy_{i-1}$, is determined as $Diff_i$, Start-up is with $Occupancy_0 = 0$.

The Centering factor provides a weighting for the occupancy to stay close to the desired occupancy at the buffer midpoint. The maximum buffer size is 5 seconds worth of data and depends on the originally encoded rate of the stream.

If $Diff_i < 0$,

$$Centering_i = Occupancy_i / Occupancy_{desired},$$

where $Occupancy_{desired}$ is the buffer occupancy which rate control tries to maintain. Otherwise,

$$Centering_i = 2 - (Occupancy_i / Occupancy_{desired}),$$

the goal being to keep the Centering factor between 0 and 2.

Then, $Beta_i$ is determined as a direct indication of how much demand varies in the network, using the Coefficient of Variation of the past and current values

the bandwidth requirements of the media can be reduced down to a minimum of 150 kbps. When the available bandwidth drops to 200 kbps, the media also is reduced to this rate, so that no receiver buffering is used to compensate for the network. However, once the available bandwidth decreases to 100 kbps, the media can only be reduced to 150 kbps, and so the receiver buffer begins to be depleted. This scenario is more robust, as the available bandwidth can drop to 150 kbps and receiver buffering is not used.

Congestion control in accordance with the invention is applicable wherever some degree of loss can be tolerated, including most video and audio codecs, with adaptable codecs being preferred. Most video codecs can be adapted by using frame dropping. Even still images can be adapted for real-time applications. JPEG and MPEG have similarities in the way they are coded, so that a technique like DRS can be used on JPEG as well. A new standard known as Flashpix has the capability to be displayed at different resolutions, and hence different bandwidth requirements when sending a picture across the Internet.

While preferred embodiments have been described above under the assumption of a wired network, composed of fiber-optic or coaxial physical cables, techniques of the invention can be used to advantage with wireless networks as well. As digital communications protocols were originally devised with wired networks in mind, most congestion-aware protocols, TCP included, assume that a lost packet indicates congestion. This is practicable in wired networks, where bit errors are uncommon. Bit errors are more common in a wireless environment, however, so that a packet is more likely to become "lost" due to an error in the packet, regardless of congestion. But known systems do not include facilities for informing

application drops the packet and sends a request for retransmission to the sender— without invoking congestion avoidance to reduce the transmission rate at the sender. If there is no error, the packet is used by the receiver application, with regular acknowledgment.

In this fashion, the likelihood of a packet being dropped by the receiver operating system due to packet error is minimized, and greater throughput is realized on wireless networks without impairing the performance on wired networks. No changes are required to the operating system nor the underlying network link layer, so long as the link layer does not perform error checking over the entire link layer packet.

This preferred technique can be used with all proprietary client-server protocols which are congestion-aware. Such protocols must be proprietary because of changes to both the client and the server. Accordingly, adaptable media applications are preferred.

Claims

1. A method for transmitting data in real time from a sender to a receiver in a digital communications network, comprising the steps of:

maintaining an estimate of bandwidth available from the sender to the receiver; and

adjusting transmission based on the estimate in order to maintain real time transmission.

2. The method according to claim 1, wherein the data comprises compressed video data.

3. The method according to claim 1, wherein maintaining the estimate of bandwidth comprises monitoring of packet loss based on acknowledgments from the receiver.

4. The method according to claim 1, wherein, in maintaining the estimate of bandwidth, the sender maintains a count of packets outstanding.

5. The method according to claim 4, wherein, in maintaining the estimate of bandwidth, the sender maintains current an upper bound on how many packets are allowed to be outstanding.

6. The method according to claim 5, wherein the upper bound is as specified by the TCP congestion window.

7. The method according to claim 1, wherein, in maintaining the estimate of bandwidth, the sender maintains a count of bytes outstanding.

8. The method according to claim 7, wherein, in maintaining the estimate of bandwidth, the sender maintains current an upper bound on how many bytes are allowed to be outstanding.

9. The method according to claim 8, wherein the upper bound is as specified by the TCP congestion window.

10. The method according to claim 1, further comprising retransmitting a packet which has been determined by the receiver as having been lost in transmission or received with an error.

11. The method according to claim 1, further comprising adapting bandwidth required by the data.

12. The method according to claim 1, further comprising discriminating between packets lost due to congestion in the network and packets received with at least one bit error.

13. A system for transmitting data in real time from a sender to a receiver in a digital communications network, comprising:

means for maintaining an estimate of bandwidth available from the sender to the receiver; and

means for adjusting transmission based on the estimate in order to maintain real time transmission.

14. The system according to claim 13, wherein the data comprises compressed video data.

15. The system according to claim 13, wherein the means for maintaining the estimate of bandwidth comprises means for monitoring of packet loss based on acknowledgments from the receiver.

16. The system according to claim 13, wherein the means for maintaining the estimate of bandwidth comprises means for maintaining a count of packets outstanding.

17. The system according to claim 16, wherein the means for maintaining the estimate of bandwidth comprises means for maintaining current an upper bound on how many packets are allowed to be outstanding.

18. The system according to claim 17, wherein the upper bound is as specified by the TCP congestion window.

19. The system according to claim 13, wherein the means for maintaining the estimate of bandwidth comprises means for maintaining a count of bytes outstanding.

20. The system according to claim 19, wherein the means for maintaining the estimate of bandwidth comprises means for maintaining current an upper bound on how many bytes are allowed to be outstanding.

21. The system according to claim 20, wherein the upper bound is as specified by the TCP congestion window.

22. The system according to claim 13, further comprising means for retransmitting a packet which has been determined by the receiver as having been lost in transmission or received with an error.

23. The system according to claim 13, further comprising means for adapting bandwidth required by the data.

24. The system according to claim 13, further comprising means for discriminating between packets lost due to congestion in the network and packets received with at least one bit error.

25. A system for transmitting data in real time from a sender to a receiver in a digital communications network, comprising a processor which is instructed for:

maintaining an estimate of bandwidth available from the sender to the receiver; and

adjusting transmission based on the estimate in order to maintain real time transmission.

26. The system according to claim 25, wherein the data comprises compressed video data.

27. The system according to claim 25, wherein maintaining the estimate of bandwidth comprises monitoring of packet loss based on acknowledgments from the receiver.

28. The system according to claim 25, wherein, in maintaining the estimate of bandwidth, the sender maintains a count of packets outstanding.

29. The system according to claim 28, wherein, in maintaining the estimate of bandwidth, the sender maintains current an upper bound on how many packets are allowed to be outstanding.

30. The system according to claim 29, wherein the upper bound is as specified by the TCP congestion window.

31. The system according to claim 25, wherein, in maintaining the estimate of bandwidth, the sender maintains a count of bytes outstanding.

32. The system according to claim 31, wherein, in maintaining the estimate of bandwidth, the sender maintains current an upper bound on how many bytes are allowed to be outstanding.

33. The system according to claim 32, wherein the upper bound is as specified by the TCP congestion window.

34. The system according to claim 25, wherein the processor is instructed further for retransmitting a packet which has been determined by the receiver as having been lost in transmission or received with an error.

35. The system according to claim 25, wherein the processor is instructed further for adapting bandwidth required by the data.

36. The system according to claim 25, wherein the processor is instructed further for discriminating between packets lost due to congestion in the network and packets received with at least one bit error.

UDP HEADER	SEQ. NUM 2 BYTES	TIMESTAMP 4 BYTES	ROUND TRIP TIME 4 BYTES	PAYLOAD

FIG. 1

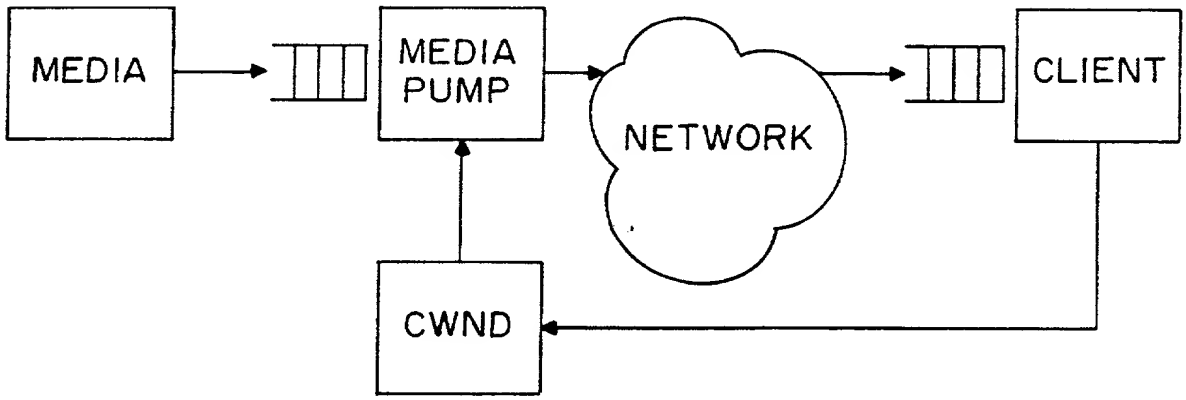


FIG. 3a

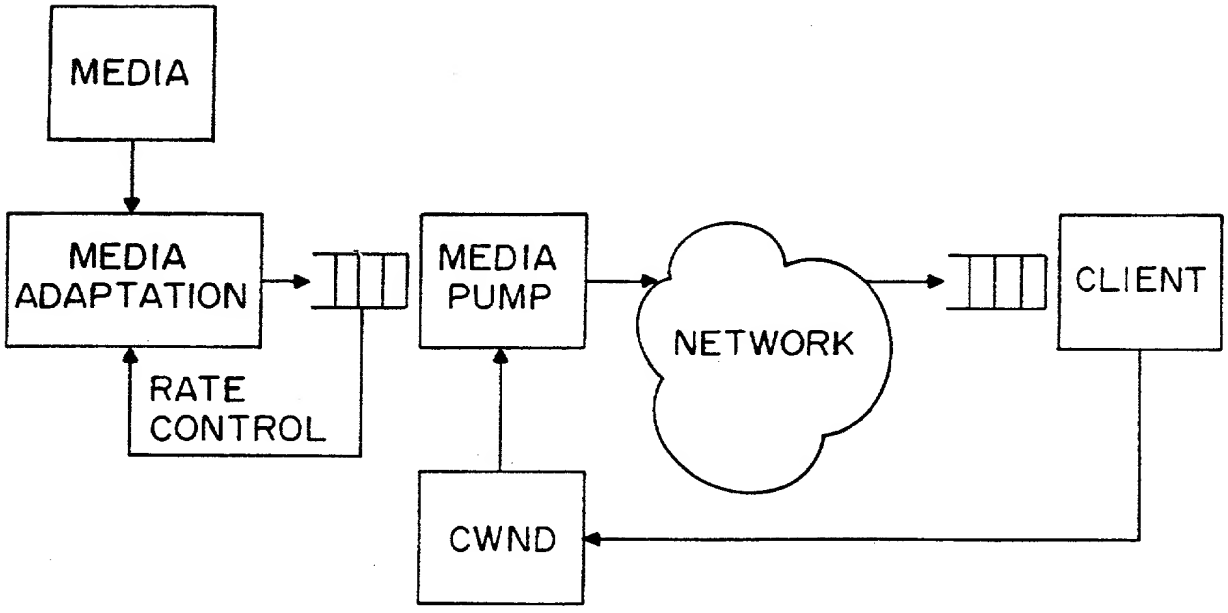
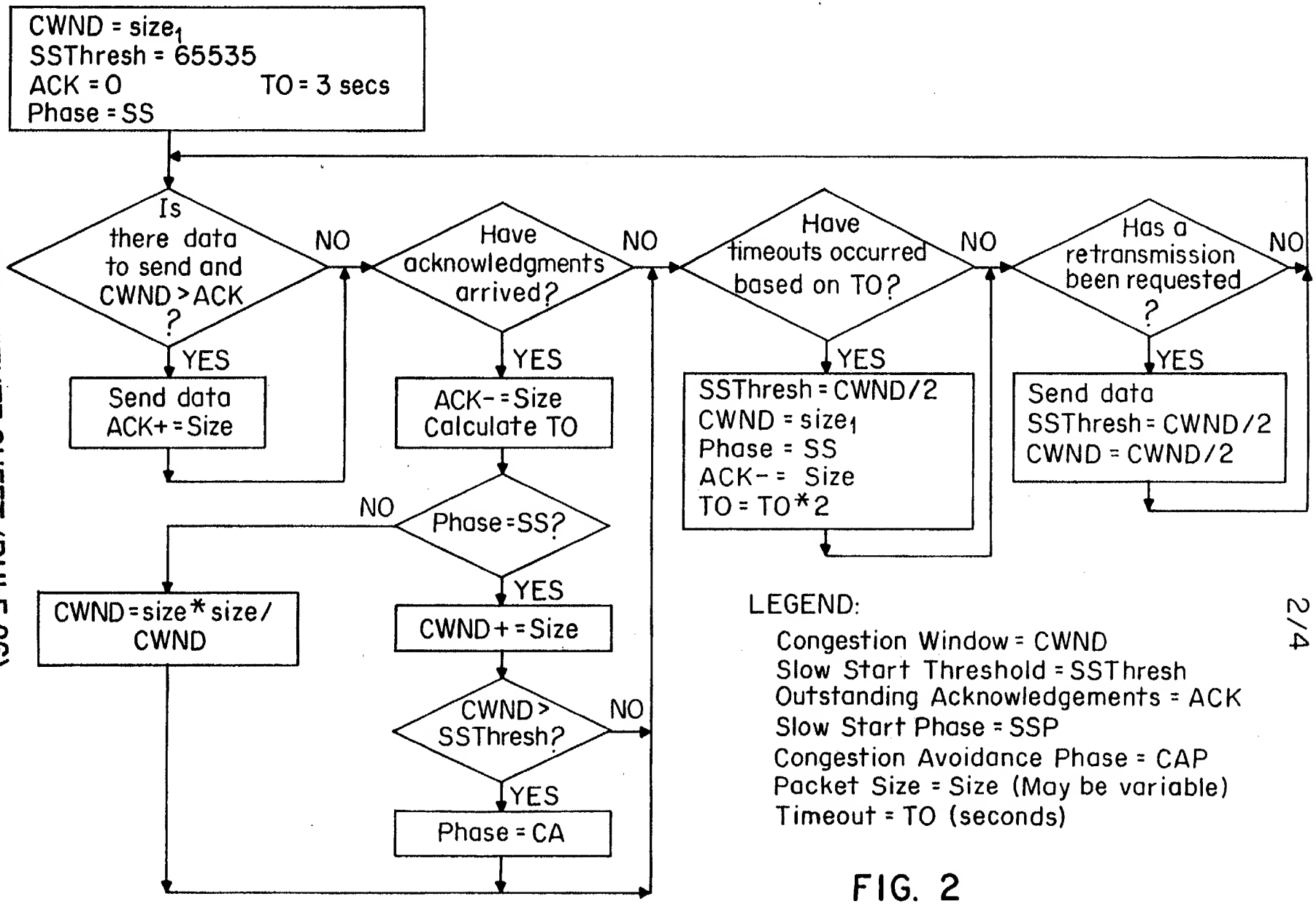


FIG. 3b



LEGEND:

Congestion Window = CWND
Slow Start Threshold = SSThresh
Outstanding Acknowledgements = ACK
Slow Start Phase = SSP
Congestion Avoidance Phase = CAP
Packet Size = Size (May be variable)
Timeout = TO (seconds)

FIG. 2

WO 99/22477
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09/530085

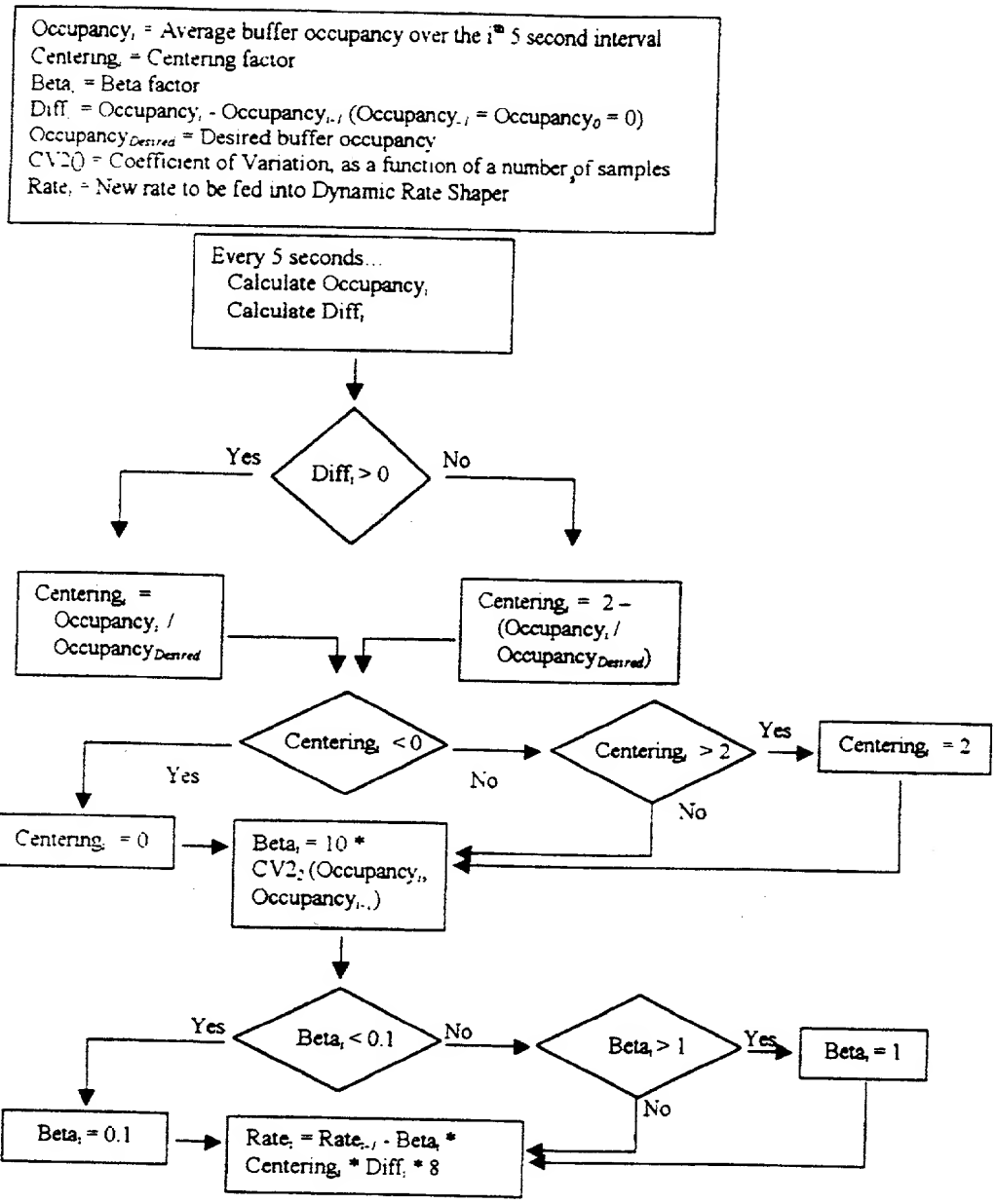
Occupancy$_i$ = Average buffer occupancy over the ith 5 second interval
Centering$_i$ = Centering factor
Beta$_i$ = Beta factor
Diff$_i$ = Occupancy$_i$ - Occupancy$_{i-1}$ (Occupancy$_{-1}$ = Occupancy$_0$ = 0)
Occupancy$_{Desired}$ = Desired buffer occupancy
CV2() = Coefficient of Variation, as a function of a number of samples
Rate$_i$ = New rate to be fed into Dynamic Rate Shaper
Every 5 seconds...
Calculate Occupancy$_i$
Calculate Diff$_i$
Diff$_i$ > 0
Yes
No
Centering$_i$ = Occupancy$_i$ / Occupancy$_{Desired}$
Centering$_i$ = 2 – (Occupancy$_i$ / Occupancy$_{Desired}$)
Centering$_i$ < 0
Yes
No
Centering$_i$ = 0
Centering$_i$ > 2
Yes
No
Centering$_i$ = 2
Beta$_i$ = 10 * CV2$_2$(Occupancy$_i$, Occupancy$_{i-1}$)
Beta$_i$ < 0.1
Yes
No
Beta$_i$ = 0.1
Beta$_i$ > 1
Yes
No
Beta$_i$ = 1
Rate$_i$ = Rate$_{i-1}$ - Beta$_i$ * Centering$_i$ * Diff$_i$ * 8

Fig. 4

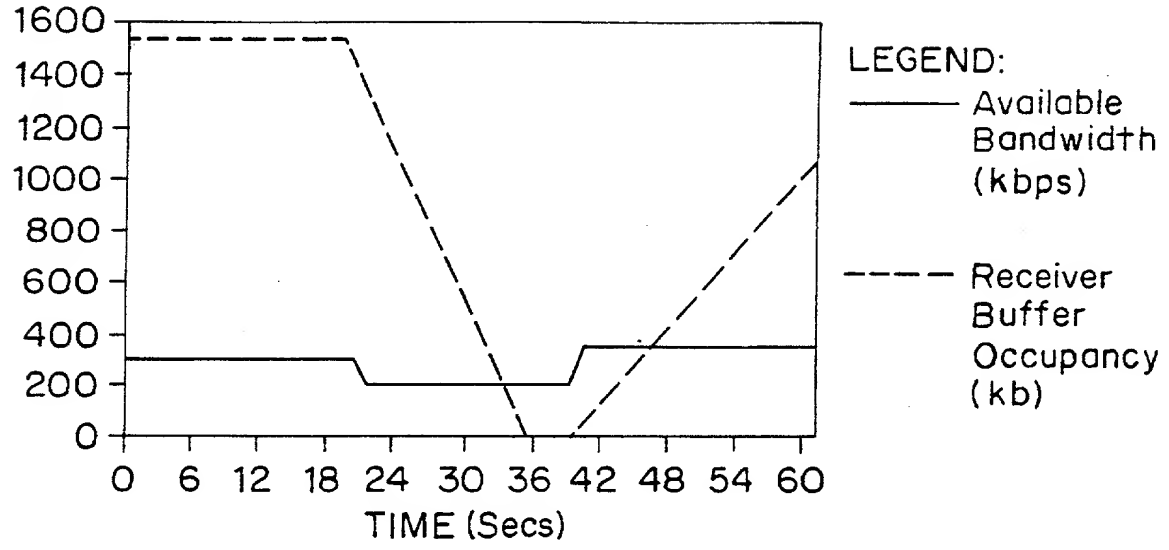

FIG. 5a

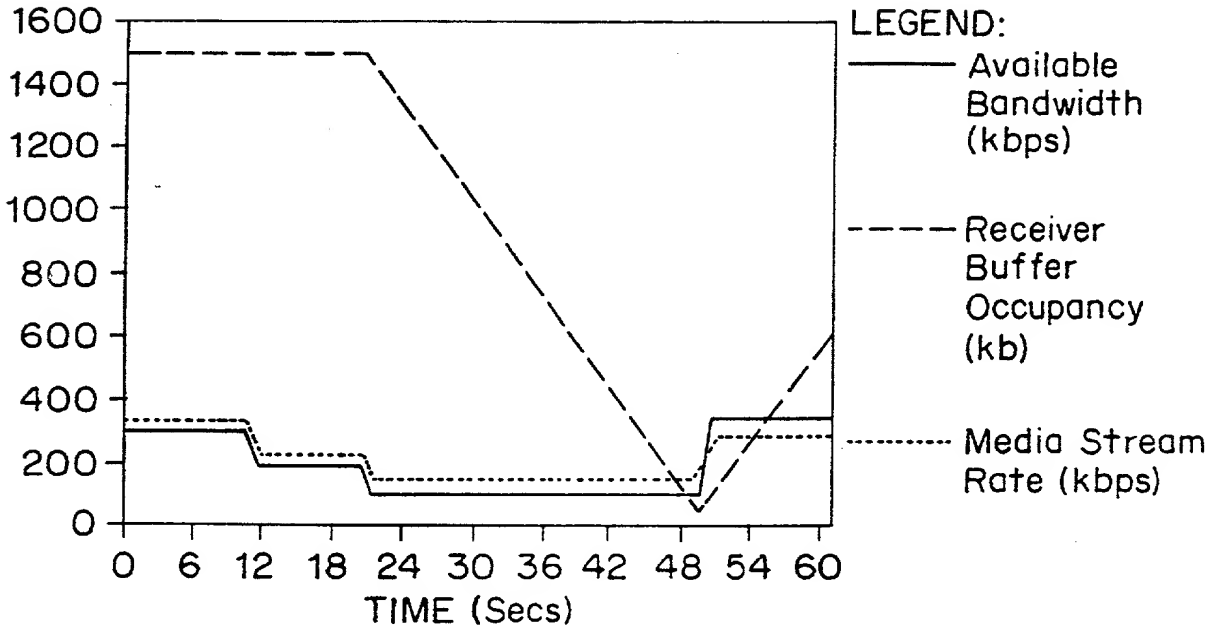

FIG. 5b

IP HEADER	UDP HEADER WITH CRC=0	APPLICATION DEFINED CRC	SEQ NUM, TIMESTAMP, AND RTT	PAYLOAD

FIG. 6

COMBINED DECLARATION AND POWER OF ATTORNEY

(Original, ~~Design~~, National Stage of PCT, Divisional, Continuation or C-I-P Application)

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TRANSMISSION CONTROL FOR MINIMIZING CONGESTION IN DIGITAL COMMUNICATIONS NETWORKS

This declaration is of the following type:

[] original
[] design
[X] national stage of PCT
[] divisional
[] continuation
[] continuation-in-part (C-I-P)

the specification of which: *(complete (a), (b), or (c))*

(a) [ ] is attached hereto.
(b) [X] was filed on April 20, 2000 as Application Serial No. 09/530,085 and was amended on *(if applicable).*
(c) [X] was described and claimed in PCT International Application No. PCT/US97/19207 filed on October 24, 1997 and was amended on *(if applicable).*

Acknowledgement of Review of Papers and Duty of Candor

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the subject matter claimed in this application in accordance with Title 37, Code of Federal Regulations § 1.56.

[ ] In compliance with this duty there is attached an information disclosure statement. 37 CFR 1.98.

Priority Claim

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT International Application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT International Application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application on which priority is claimed

(complete (d) or (e))

(d) [X] no such applications have been filed.
(e) [ ] such applications have been filed as follows:

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION			
COUNTRY APPLICATION NO.	DATE OF FILING (day, month, year)	DATE OF ISSUE (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
			[ ] YES NO [ ]
			[ ] YES NO [ ]
			[ ] YES NO [ ]
ALL FOREIGN APPLICATION[S], IF ANY, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION			
			[ ] YES NO [ ]
			[ ] YES NO [ ]
			[ ] YES NO [ ]

Claim for Benefit of Prior U.S. Provisional Application(s)

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

Provisional Application Number	Filing Date

Claim for Benefit of Earlier U.S./PCT Application(s) under 35 U.S.C. 120

(complete this part only if this is a divisional, continuation or C-I-P application)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose information as defined in Title 37, Code of Federal Regulations, § 1.56 which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PCT/US97/19207	October 24, 1997	Pending
(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

Power of Attorney

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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